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LAND INNOVATION FUND
FOR SUSTAINABLE LIVELIHOODS

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CENTER FOR CONSERVATION AND SUSTAINABILITY SCIENCE

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Executive summary:

Mental maps of rural producers on land use change in MATOPIBA

This executive summary presents the main results obtained in the first phase of the project "Incentives and interventions for behavior-based policies for a soy production chain free of deforestation and conversion in the Cerrado". This project uses behavioral sciences to map out criteria that influence soybean producers' decision-making about the use of their land in the Cerrado. The results of their behaviors will embase the design of mechanisms that encourage the voluntary conservation and restoration of native vegetation and the adoption of sustainable agricultural practices.

This study was conducted by the **Center for Conservation and Sustainability Science of PUC-Rio (CSRio)** in partnership with the **International Institute for Sustainability (IIS)**, and was funded by the **Land Innovation Fund (LIF).**

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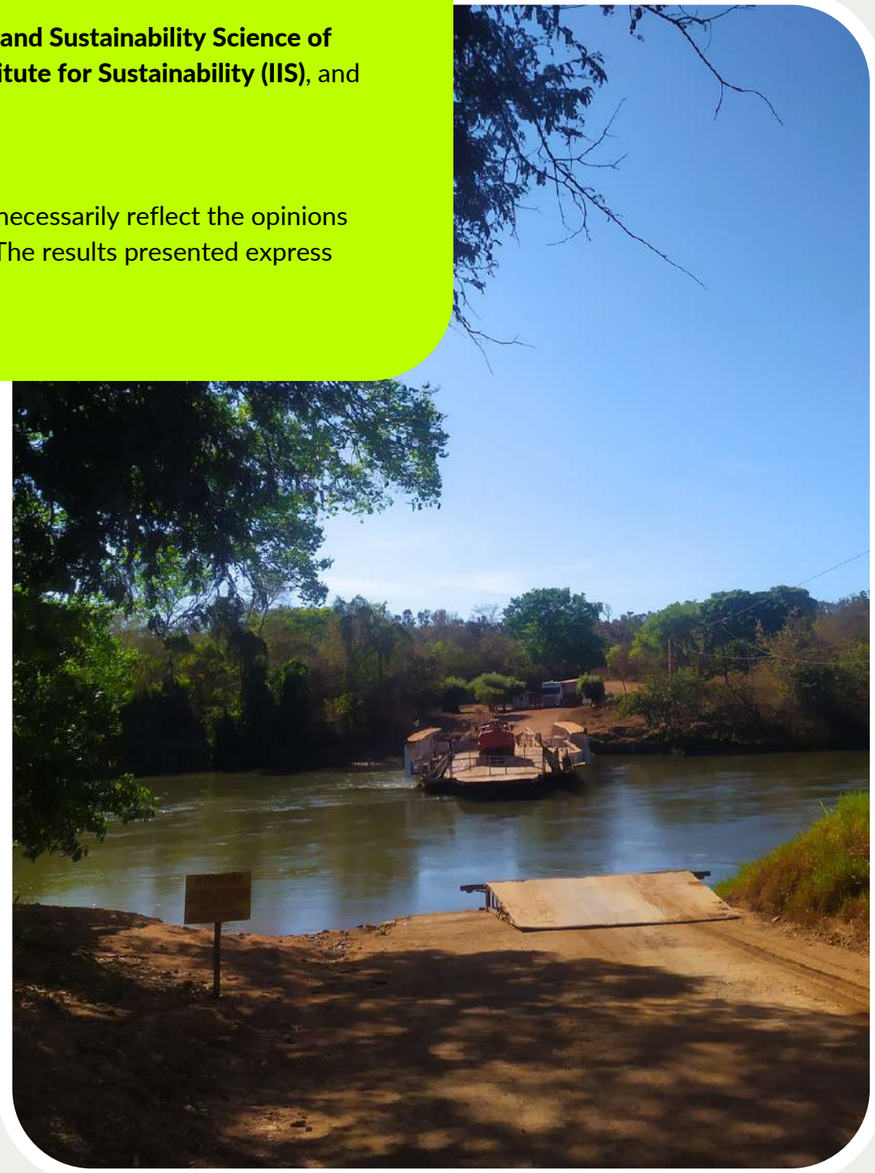
Introduction



Most of the agricultural expansion in MATOPIBA has taken place over native vegetation, unlike other areas of the Cerrado, where crops are being established on pastureland. This indicates that approximately two-thirds of the current native vegetation cover in the Cerrado, suitable for agriculture, is at risk of being converted for other uses, mainly soybean cultivation.

Therefore, efforts should be directed towards the implementation of policies aimed at reducing legal deforestation and encouraging voluntary conservation of native vegetation, which, in addition to environmental and climate benefits, ensures Brazilian producers access to the deforestation-free commodity market.

This research aimed to identify and evaluate the behavioral factors of MATOPIBA's rural producers that influence their decision-making regarding land use. For this, mental maps of different producer groups in the region were generated, based on 60 interviews conducted between August and December 2022 in the states of Maranhão, Tocantins, Piauí, and Bahia.

In some cases, there was a divergence in the interviewees' opinions, due to the context, local vegetation, and producer profile. This is evident, for example, in the perception of the soil quality in the Cerrado, seen as fertile in some regions and less fertile in others.

The results will subsidize the development of solutions and incentives to eliminate deforestation from the Cerrado soybean chain.

Access the full report below (in portuguese only):

https://www.iis-rio.org/publicacoes/sumario-executivo-mapas-mentais-sobre-mudanca-de-uso-do-solo-no-matopiba

Glossary:

APP: Permanent Preservation Area
CRA: Environmental Reserve Quotas
ILP: Integration of Crops-Livestock
ILPF: Integration of Crops-Livestock-Forestry
MATOPIBA: Cerrado region formed by parts of the states of MAranhão, TOcantins, Plauí e BAhia
PES: Payment for Ecosystem services
RL: Legal Reserve
ha: hectares

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Profile of the soybean producers, producers of other crops, and cattle ranchers interviewed

	Soybean producers	Cattle ranchers and producers of other crops
Number of interviews conducted	40 (10 in each state of MATOPIBA)	20 (10 in areas suitable for soy cultivation and 10 in non-suitable areas)
Number of respondents	45 (36 men and 9 women)	24 (18 men and 6 women)
Property size	80% of the interviewees own properties ranging from 501 to 10,000 hectares	50% of the respondents own properties up to 500ha
Age group	Predominance of 31 and 40 years	Predominance of 61 to 70 years old
Education level	The predominant level of education in this group (38%) is of completed higher education	The predominant level of education in this group (40%) is of completed high school education
Origin	The majority of interviewees is the third generation of farming families that migrated from the South of the country	The majority of interviewees is originally from the state where the interview was conducted (property's location) and inherited the property from their family
Decision making	They make the decision after consulting other sources such as agronomists, agricultural consultants, family members, and neighbors	Approximately 50% make decisions on their own, without consulting any specialist

Together, the interviewees own 166,317 thousand hectares (ha) of land, of which 80,063 thousand ha are used for the cultivation of soybean and other crops (main and secondary crops), and 5,447 thousand ha are dedicated to livestock.

Main reasons for migration:

Low land prices compared to other Brazilian states, which allowed some producers to fulfill the "dream of owning their own land" and signaled that the region was an agricultural frontier;

Suitability of the MATOPIBA lands for soy cultivation. Despite the lands being less fertile than the rich soils of southern Brazil, the producers valued the flat areas of the region and relied on soil correction with limestone, phosphorus, and other nutrients to ensure good productivity.

Regularity of rains, with clearly defined dry and rainy seasons.

Why plant soybean in MATOPIBA?

"We come from producers, it's in the blood, this doesn't happen overnight."

- **The family** has always performed this role;
- **resilience of soybean** to periods of drought thanks to the advent of genetically modified seeds developed for this purpose;
- **rapid growth** due to the region's climate (in the South, seed germination takes longer);
- good **adaptation to the soil**, when corrected with limestone, gypsum and phosphorus **(even if previously degraded)**;
- **high profitability and liquidity** of soybean, which, according to the interviewees, is **superior to that of any other agricultural economic activity practiced in the region**.

Adoption of sustainable practices

All soybean producers interviewed said they already adopt sustainable practices on their properties.

Motivations to adopt sustainable practices:

- improvement in **production outcomes**;

"—If someone wants to know what being sustainable is, they need to come here to know the production; because a producer who is not sustainable cannot maintain themselves."

- **cost reduction** compared to conventional practices;
- improvement of **soil quality**, which would also ensure an enhancement in production:

"— Cerrado has infertile soil; producers who want to succeed need to invest in these techniques."

Barriers to adopting sustainable practices:

- **high cost**, especially due to an increase in input prices in recent years;
- **region's climate**, which suffers from long periods of water stress;
- **transportation logistics**, especially regarding freight cost;
- **technical specifications** for implementation (lack of knowledge about the process).

Association between adopting sustainable practices and environmental conservation:

For the majority of respondents, the concept of sustainability is seen only from the business perspective (sustainability of the economic activity), it is not related to the environment.

Most adopted sustainable practices among soybean producers:

1. **direct planting;**
2. **biological nitrogen fixation;**
3. **use of biological inputs;**
4. **planting on contour lines;**
5. **integrated management of pests, diseases, and weeds."**

Scenary 1
Degraded area

When asked what they would do with a degraded area in their properties that already had APP and RL regularized in another area, the producers' responses varied between:

	Soybean producers	Cattle ranchers and producers of other crops
Recover to plant soybeans	22	3
Recover for cattle ranching	3	8
Recover for ILP or ILPF	5	1
Keep degraded	2	3
Restore native vegetation	2	3
Depends	8	1
Total	42*	19

*Not all respondents answered the question.

1 Recover the degraded area to plant soybeans:

Motivations:

- **value** of financial return;
- **speed of financial return;**
- desire to **increase production** to "feed the world";
- **soil recovery** due to cultivation;
- **family tradition** of planting soybean;
- waiver of **environmental license** for suppression of native vegetation.

Barriers:

- **costs** of inputs, machinery and fuel;
- **taxes** on production;
- time for **soil recovery;**
- lack of **skilled labor;**
- lack of **technical assistance** for machinery maintenance.

2 Recover the degraded area for pasture:

Motivations:

- increase **the herd**;
- **less expensive** than recovering for soybean crop;
- brachiaria helps soil recovery (**increases organic matter** for future transformation into soybean farming).

Barriers:

- **cost of inputs** for soil recovery;
- lack of **skilled labor;**
- cost of inputs for **livestock farming** (grass seeds, feed, medication etc);
- **rise in fuel prices** (diesel) for machinery.

3 Recover the degraded area for crop-livestock integration (ILP) or crop-livestock-forestry integration (ILPF)

Motivations:

- livestock or timber exploitation can represent a **second source of income after farming**;
- implement **crop rotation** (favors soil recovery);
- **animal welfare** (shade for cattle);
- implement **rotational grazing**.

Barriers:

- **costs** with machinery and inputs;
- increased **risk of fires;**
- lack of **skilled labor;**

4 Restore the native vegetation of the degraded area:

Motivations:

- it can be an **advantageous alternative** for areas not suitable for agriculture or livestock;
- **low cost of natural regeneration** compared to soil recovery for cropping or pasture;
- potential **income generation** with the extraction of commercial timber;
- improvement of the **microclimate** on the property;
- presence of **native fauna**;
- protection against the **spread of fires**.

Barriers: **costs and labor** needed to fence the area.

5 Keep the degraded area:

Reasons:

- in some cases, **the costs** to recover the soil do not justify the investment;
- **political instability in the period** (pre-presidential elections);
- profit from **future financial compensations** for the restoration of native vegetation;
- **potential for natural regeneration** of the Cerrado;
- **lack of financial resources** and workforce for recovery.

6 Depends:

- **on the agricultural suitability of the area**. If favorable for agriculture, they would plant soybean; if not, eucalyptus or pasture for cattle;
- **on the financial return** obtained from soybean cultivation or livestock, deducting costs of recovery, which vary according to the terrain's conditions and the level of degradation;
- **on the availability of equity capital for investment**. Otherwise, they would leave the area "fenced off" until it recovered its grassland form for raising cattle.

Expansion of soybean farming in native vegetation or degraded areas?

Motivations to expand crop cultivation in native vegetation areas:

- **lower land prices** compared to already cleared or mechanized areas;
- **soil quality** (in Cerrado regions where the soil of "virgin" land is more fertile):

Motivations to expand crop cultivation in already cleared (former pasture) areas, even if degraded:

- **reduction of bureaucracy** and **waiting time** to obtain a license to clear native vegetation.

"— A degraded area requires a lot of correction; in the first few years, productivity is very low, there are more nematodes, and the soil is more acidic. Because of this, most producers, including myself, prefer an area that was native Cerrado when buying land, despite the licensing and bureaucratic issues involved in clearing it".

Scenary 2
Surplus of Legal Reserve (RL)

When asked about what they would do with an area of surplus native vegetation in their properties (apart from APP and RL), the producers' responses varied between:

	Soybean producers	Cattle ranchers and producers of other crops
Clear to plant soybean	21	1
Clear for livestock farming	1	5
Conserve voluntarily	9	10
Depends	8	3
Total	38*	19

*Not all respondents answered the question.

1 Clear to plant soybean:

Motivations:

- **financial return** from soybeans due to the crop's high market value;
- **appreciation of mechanized (cleared) land** at the time of sale.

"— We pay for 100% of the land, and we already have to set aside a percentage without using it (Legal Reserve), and no one gives us anything for it. If I paid for the land, I want to see it making a profit"

- **increase in cultivated area** ("desire to plant");
- food **production**;
- promotion of **economic development in the region** by attracting investments and generating employment;
- **suitability for soybean cultivation** in a significant part of the MATOPIBA region: areas covered by native vegetation have more fertile soil than degraded areas and yield **positive harvest results** since the first year of cultivation;
- **environmental benefits** of agricultural cultivation.

"— There are no advantages in the Cerrado, it is best to incorporate cultivation. The cultivated area even sequesters more carbon".

Barriers:

- **high cost of investment** for the removal of native vegetation and preparation for cultivation;
- **scarcity of qualified labor** to operate machinery, clear land, remove stump and root etc.;
- **bureaucracy and waiting time** to **obtain environmental permits**, which can take 3 to 5 years;
- **topography**, as areas with steep slopes **are not be suitable for soybean cultivation**;
- potential **impacts on the local community**, which relies on the extraction of native species like babassu for subsistence.

2 Clear for livestock farming:

Motivations:

- **diversification of the economic activity** in the property (in the case of soybean producers);
- **expantion of pasture area** and consequent increase in the size of the livestock herd (in the case of livestock farmers);
- **appreciation of the rural property**.

Barriers:

- **high financial investment** required for land clearing, which in some cases can be equivalent to the cost of acquiring a new area;
- **cost** of pasture management.

3 Conserve voluntarily:

Motivations:

- **political uncertainty** at the time of the interview and concerns about possible taxation of soybean production;
- **satisfaction with current production** and no need to expand the production area.

"— Financially, we have already achieved a lot. Today, we are fulfilled and no longer see the need for further growth"

- **avoid costs to clear the land (deforest) and the bureaucracy** to obtain a license to suppress native vegetation;
- **future business opportunity** in the market of Environmental Reserve Quotas (CRA) trading;
- **regulate the water regime** and **increase water availability** in the region;
- **pleasure** of living close to areas of natural vegetation and its wildlife:

"— I am extremely protective of my forest, it is incredibly beautiful; even my grandchildren are crazy about going there, walking around and seeing the animals; there are monkeys, Brazilian guinea pigs, white-lipped peccary".

- low-lying areas **unsuitable for agriculture** exist within the property, which ends up benefiting local agro-extractive families:

"— We have areas we don't touch that could even [qualify for a PES for conservation], as they are not suitable for soybean cultivation. Here, we even let people collect things for their subsistence. We would conserve them even without payment".

Barriers:

- **loss of potential revenue** that could be obtained from soybean cultivation in the area;
- **low appreciation of the rural property** compared to a fully mechanized property;
- **risk of land invasion** since, according to the producer, an area of native vegetation could attract the attention of land grabbers;
- **legal insecurity:** uncertainties in the regulation of the Environmental Reserve Quotas (CRA) mechanism and concerns about the implementation of a soy or cattle moratorium in the Cerrado.

4 Depends

- **on the agricultural suitability** of the area to make the decision. If it was favorable for agriculture, they would plant soybeans; if not, they would consider planting eucalyptus or establishing pasture for livestock;
- **on the personal financial availability at the time of the decision**. If they had sufficient resources, they would clear the area for crop cultivation or pasture; if not, they would leave it as is (with natural vegetation);
- **on the health condition of the head of the family**. If they were physically weakened, they would not disturb the area.

Payment for Ecosystem Services (PSE) to restore or conserve native vegetation

Rural producers who did not opt for spontaneous conservation or restoration were asked if they would accept a PES to voluntarily conserve or restore the degraded area. The following responses were obtained:

Acceptance of PES	Soybean producers	Livestock farmers and producers
1. Restoration		
Would accept	13	5
Would not accept	8	5
Depends	9	2
Total	30	12
2. Conservation		
Would accept	9	4
Would not accept	6	2
Depends	7	0
Total	22	6

"—Every producer has the dream of earning income from this land"

Preferences regarding the frequency of receiving a PES for voluntary restoration or conservation of native vegetation:

The majority of respondents **did not know how to answer or did not have a preference** for the payment frequency; Some **soybean producers would prefer to receive the benefit annually**:

"—The producer's mind works better on an annual basis"

What would be a fair amount for a PES for the restoration or conservation of native vegetation in an area outside of APP or RL in your property?

38% of respondents estimated the **equivalent of the annual profit from soybean cultivation** per hectare, which varied between **R$ 1,000 and R$ 2,000/ha**.

17% would accept a value **equivalent to the lease of the land** (10 to 12 bags of soybeans/ha, which on April 14, 2023, was costing R$144.60, i.e., between **R$1,446.00 and R$1,735.20**);

If the area in question was not suitable for cultivation, or if there was some **"*environmental cause behind it*",** a producer would accept a lower value than **"*what they would earn with soybean cultivation*"**; One producer would accept between **R$500 and R$1,000/ha**, as **"anything that comes from these idle areas is profit"**; Some respondents would only accept a PSE for voluntary conservation **if the amount was higher than a payment for the restoration of the degraded area**, as land covered with native vegetation is more fertile, and therefore more valuable.

Fair value for PES per hectare	Soybean producers	Cattle ranchers and producers of other crops
1. Restoration		
Soybean profit (R$1 to R$2 thousand/ha)	6	0
Doesn't know	5	3
Leasing value (approx. R$1.5 thousand/ha)	3	0
R$1 thousand/ha	1	0
From R$ 500 to R$ 1 thousand/ha	1	1
Total	16	4
2.Conservation		
Soybean profit (R$1 to R$2 thousand/ha)	5	0
Doesn't know	4	6
Leasing value (approx. R$1.5 thousand/ha)	2	0
R$1 thousand/ha	1	0
From R$ 500 to R$ 1 thousand/ha	1	2
Total	13	8

Preference for the institution proposing a PES for restoration or conservation of native vegetation outside the property's APP or Legal Reserve:

1 Traders

The majority of soy farmers trust traders more: **"— They are more committed to the farmers".**

The traders mentioned spontaneously were **Cargill, Bunge, and CHS**.

2 Banks and private companies of the agro sector

Banks (**"— They supervise, so things would be more certain"**) and private companies from the agro sector (**"— If they fail to comply, it's easier to reclaim rights"**) were the second most mentioned institutions by the soybean producers.

The banks spontaneously mentioned were **Banco do Brasil, Banco da Amazônia, Banco do Nordeste, and Sicredi;**

3 Third sector organizations

The only third sector organization that soybean producers trust are producer associations, **such as APROSOJA**.

"— "In today's world, you can't trust anyone. We're smart about that here: the poorest are always the most deceived, there's no point in believing".

LEAST trusted institutions by producers to establish a PSA contract for voluntary restoration or conservation of native vegetation:

The government is the institution that producers trust the **LEAST** to establish a PES contract for voluntary restoration or conservation of native vegetation. Some producers also stated they do not trust private companies, especially foreign ones, banks, and third-sector organizations.

The only institutions mentioned by soybean producers as solely trustworthy are traders and agricultural associations.

Barriers for the acceptance of a PSA for voluntary restoration or conservation of native vegetation:

Fear of facing penalties for events beyond the owner's control.

These events could be a natural disaster, fire, hunting or illegal timber extraction by third-party intruders during the contract period.

“—There has to be a guarantee that the area will not have issues with fire or hunters; so you make a contract for a certain amount of time and if something happens during that time, the person will have to pay a fine without being responsible for it.”

Disbelief in the viability of a PSA:

One producer referred to PSA as an "illusion", claiming some receive it while others don't.

" — this (PSA) is a thing of countries that have already deforested and now want to hinder Brazil's growth.”

“— The producer is always looking for ways to improve their area. Our payment comes from the harvest; I don't believe at all that one day someone will come to offer anything for it.”

Disbelief in the value of Cerrado.

The native vegetation is ***“too sparse”***, so it ***“is not worth it”*** to conserve or restore, it would be better to maintain the native vegetation only in the lower areas, ***“where there are trees, and to plant in the plateaus (chapadas), where it is suitable for agriculture”***.

Love for planting

"— Watching the soybeans sprout and develop”.

High financial return from soybeans

The value of the PSA would not cover the financial return obtained from soybean cultivation: ***"it's very difficult to surpass the value of soybeans."***

Preference for the cultivation of non-native species

Possibility of implementing an **eucalyptus plantation** in the degraded area, a **timber cultivation with a short cycle,** and **quick financial return**.

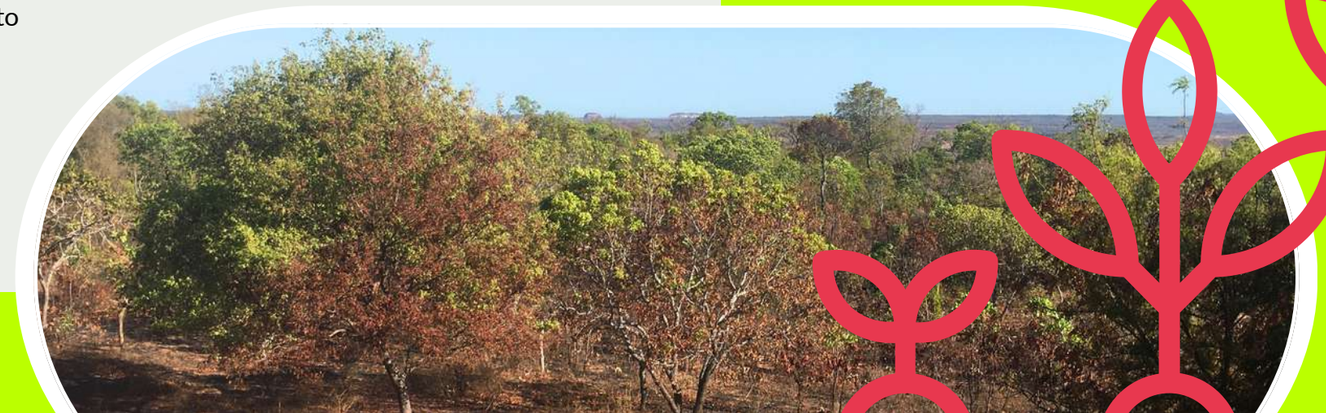
Soil fertility

A producer stated that they would consider a PSA to restore a degraded area, but not o conserve an area of native vegetation which, according to them, ***"is good for production."***

Potential financial return

Potential financial return from the incentive, in comparison to other land uses, such as agriculture or livestock.

“— A mechanized area, ready for cultivation, is worth up to five times more than an area of native vegetation; and a PSA for restoration or conservation would hardly surpass this gain”



Factors to accept a PSA for voluntary restoration and conservation of native vegetation:

Agricultural suitability of the area in question

If the area is not suitable for soybean production, they would accept the payment, but if it is suitable, they would **"plant on up to 100% of the area."**

Benefits for the environment and community

Benefits that the restoration of the area in question would bring to the environment and to the community (e.g., recovery of a spring or formation of an ecological corridor).

Financial capacity of the PSA payer

Financial capacity of the PSA payer in the event that many producers adhere to the program, especially if the payer is the government.

Contract terms

Issues such as value, duration, and payment method.

Possibility of income during the rainy season

Possibility of sustainable extraction of wood for domestic use and the release of cattle (in the case of small livestock farmers) during the rainy season, to feed on the foliage.

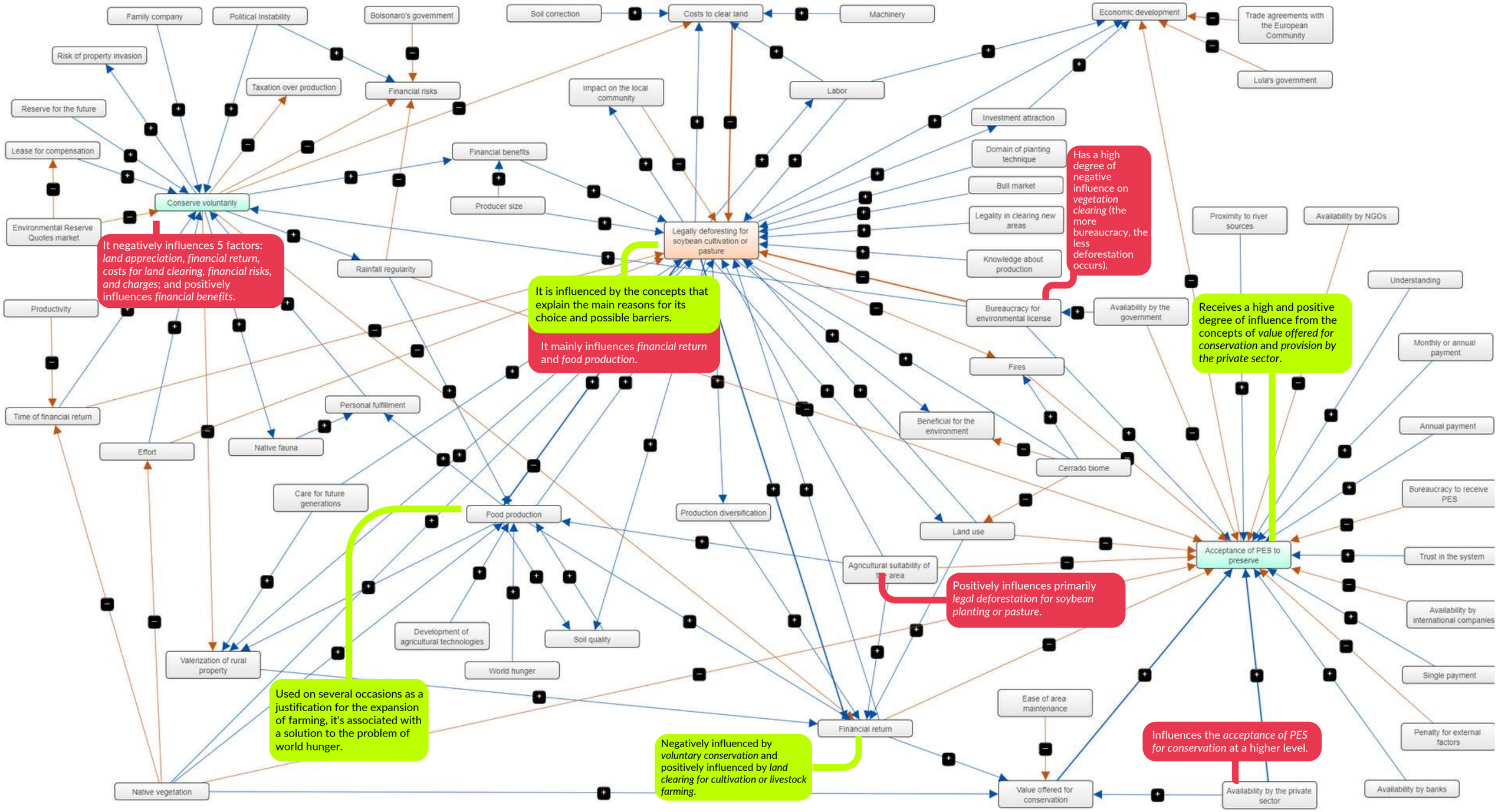
Size of the area in question

If it's too small, it wouldn't be worth it due to the low value of the compensation received.

Mental Map

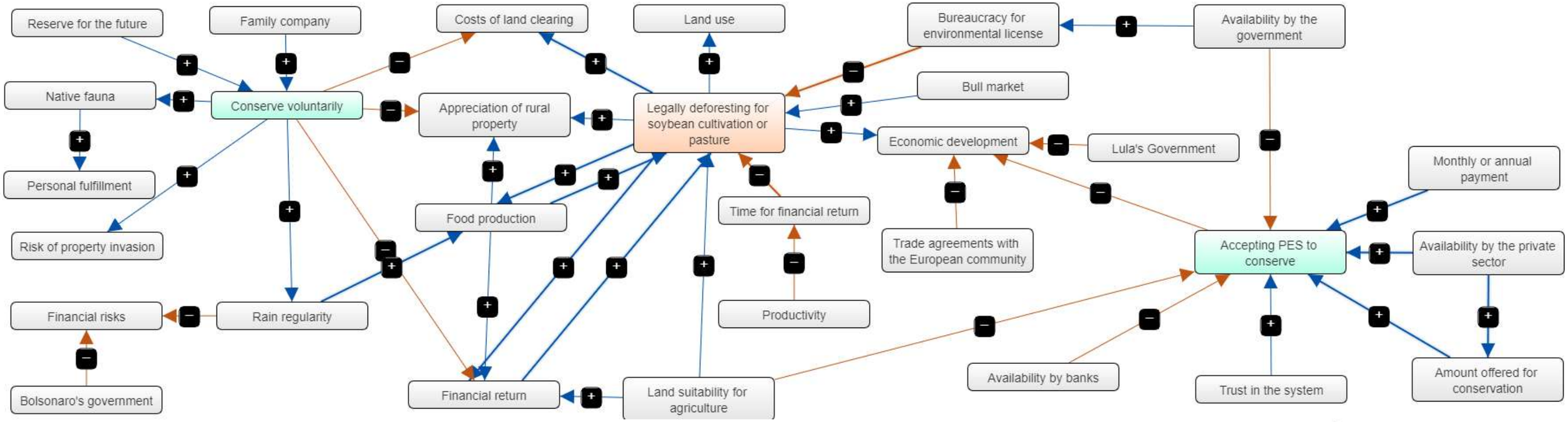
Soybean producers from MATOPIBA in relation to the voluntary conservation of native vegetation

The blue lines indicate positive relationships between the variables (if A increases, then B also increases) and the orange lines indicate negative relationships (if A increases, then B decreases). The width of the line indicates the strength of the relationship: the thicker the line, the greater the number of mentions of A's influence on B, and the thinner, the fewer the number of mentions. The arrow indicates the direction of the relationship (A influences B). In the green boxes, the most influenced components are indicated; and in the pink boxes, the componentes that most influence others.



Mental Map

Soybean producers from Bahia (BA)



Components that most influence and are influenced by others:

1. **legally deforesting for soybean or pasture cultivation;**
2. **acceptance of a PES for voluntary conservation of native vegetation;**
3. **food production;**
4. **voluntary conservation;**
5. **financial return.**

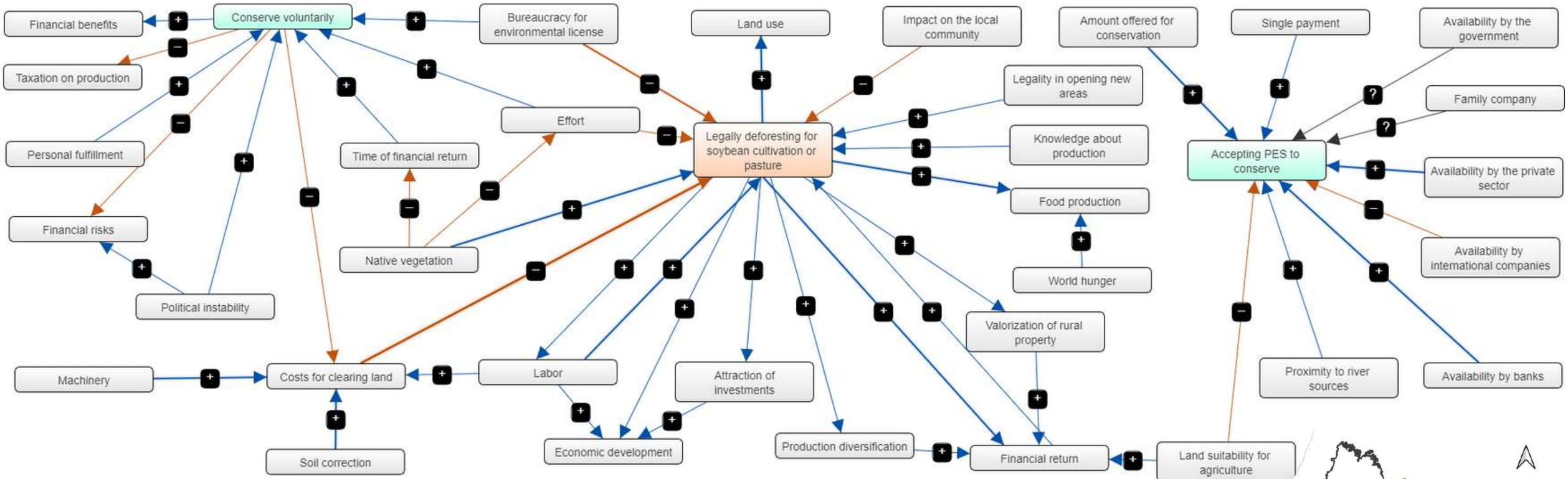
Factors unique to the concept map compared to other states:

- trust in the system;
- native fauna;
- Bolsonaro's government;
- Lula's government;
- risk of property invasion;
- monthly or annual payment;
- trade agreements with the European community;
- productivity;
- reserve for the future.

The blue lines indicate positive relationships between the variables (if A increases, then B also increases) and the orange lines indicate negative relationships (if A increases, then B decreases). The width of the line indicates the strength of the relationship: the thicker the line, the greater the number of mentions of A's influence on B, and the thinner, the fewer the number of mentions. The arrow indicates the direction of the relationship (A influences B).

Mental Map

Soybean producers from Maranhão (MA)



Components that most influence and are influenced by others:

1. **legally deforesting for soybean or pasture cultivation;**
2. **costs of land clearing;**
3. **acceptance of a PES for voluntary conservation;**
4. **voluntary conservation;**
5. **costs of land clearing.**

Factors unique to the concept map compared to other states:

- lower taxation on production;
- provision of PES by foreign companies;
- diversification of production;
- effort;
- world hunger;
- attraction of investments;
- one-time payment;
- proximity to river sources.

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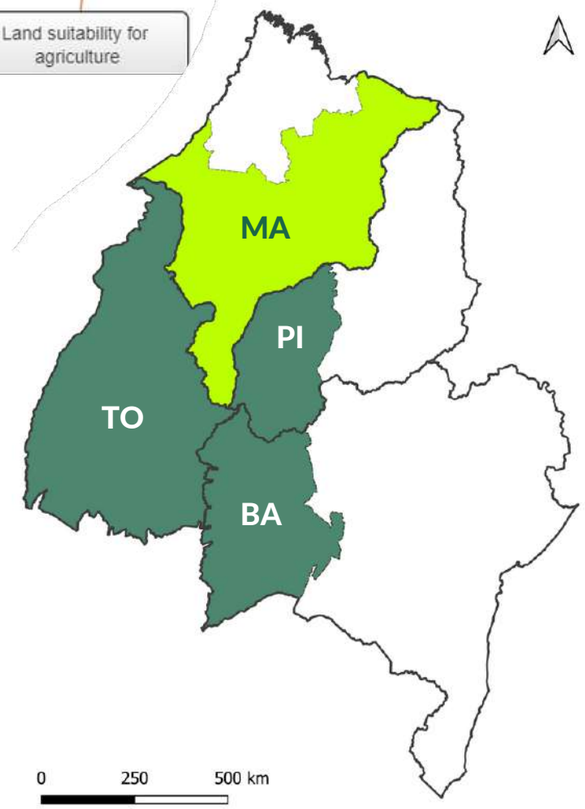
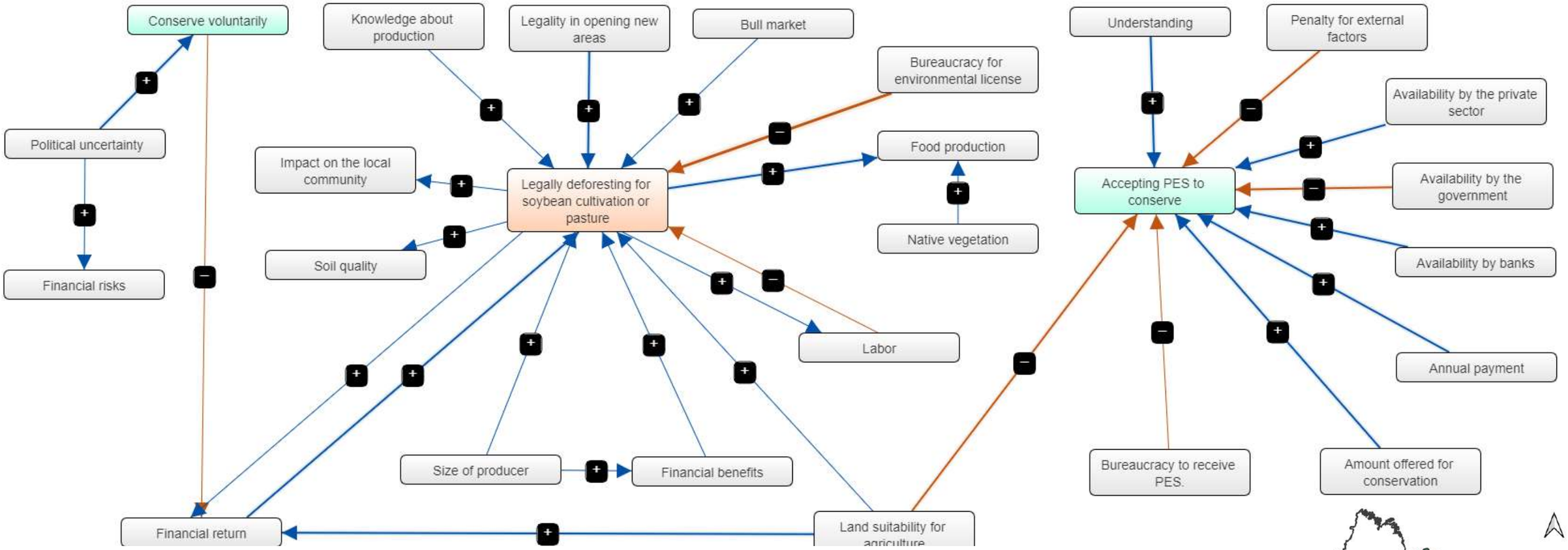


Mental Map

Soybean producers from Tocantins (TO)



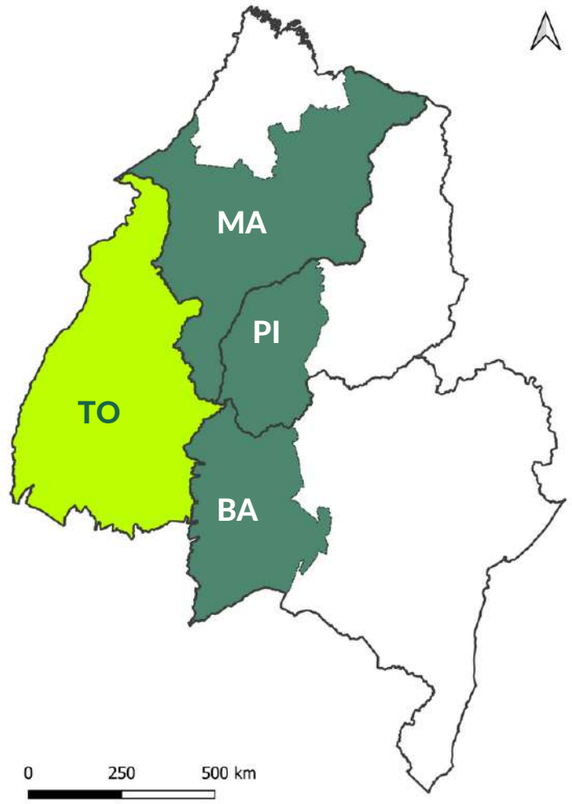
Components that most influence and are influenced by others:

1. **acceptance of a PES for voluntary conservation;**
2. **legally deforesting for soybean or pasture cultivation;**
3. **land suitability;**
4. **financial return;**
5. **bureaucracy to obtain environmental permits (for native vegetation suppression).**

Factors unique to the concept map compared to other states:

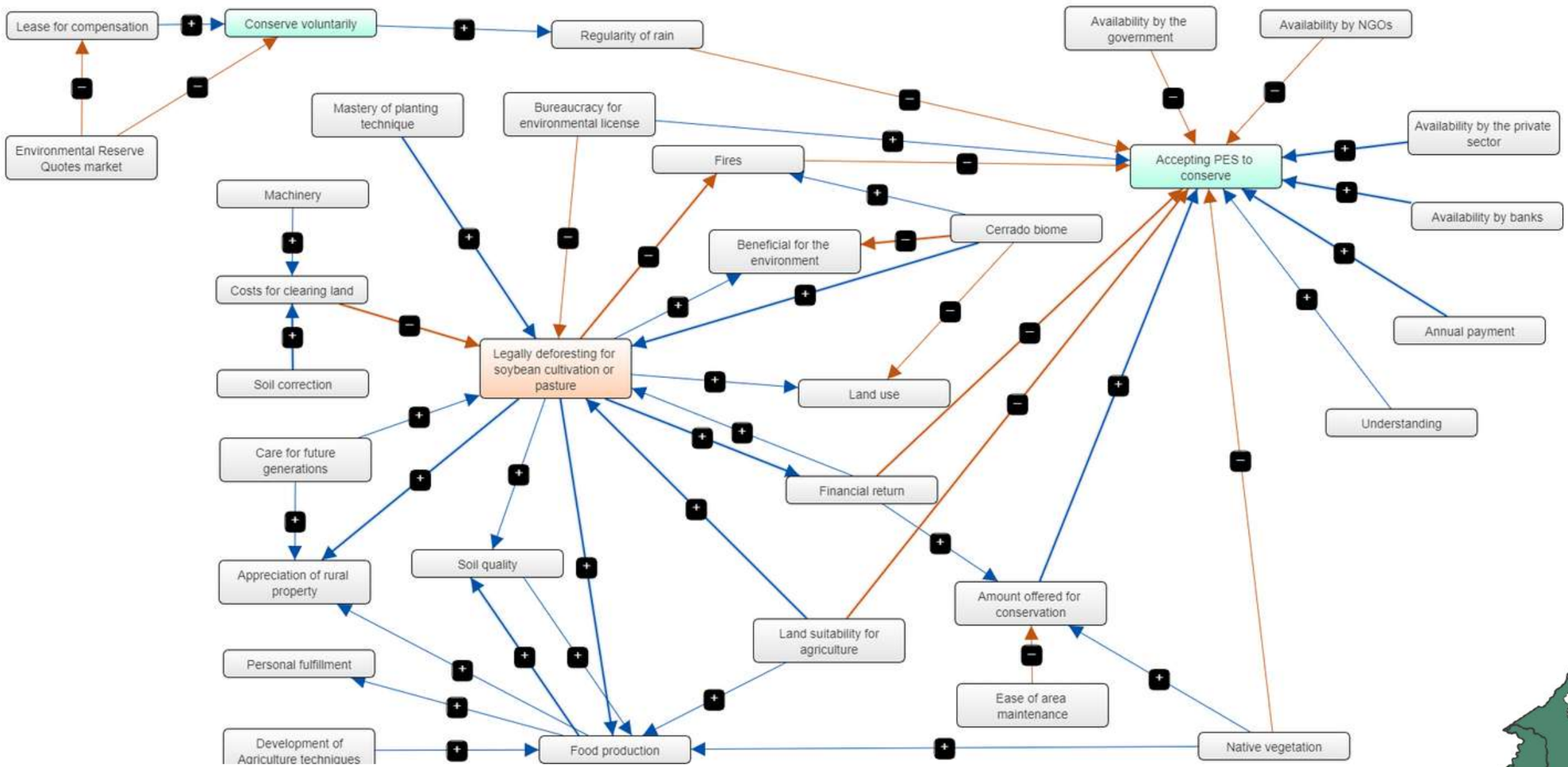
- bureaucracy to receive PES;
- penalization due to external factors;
- size of the producer.

The blue lines indicate positive relationships between the variables (if A increases, then B also increases) and the orange lines indicate negative relationships (if A increases, then B decreases). The width of the line indicates the strength of the relationship: the thicker the line, the greater the number of mentions of A's influence on B, and the thinner, the fewer the number of mentions. The arrow indicates the direction of the relationship (A influences B).



Mental Map

Soybean producers from Piauí (PI)



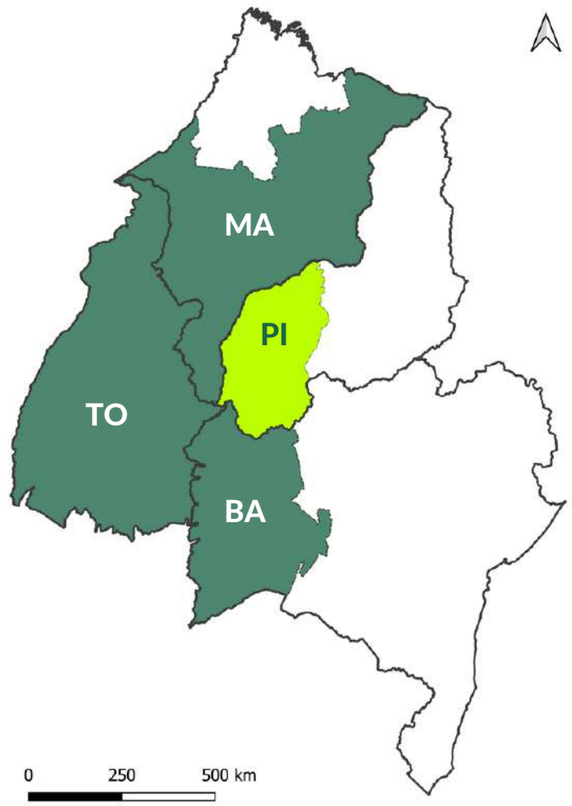
Components that most influence and are influenced by others:

1. **legally deforesting for soybean or pasture cultivation;**
2. **acceptance of a PES for voluntary conservation;**
3. **food production;**
4. **land suitability of the area;**
5. **financial return;**

Factors unique to the concept map compared to other states:

- leasing for environmental compensation;
- benefit to the environment;
- care for future generations;
- provision of PES by non-governmental organizations (NGOs);
- Cerrado biome;
- ease of area maintenance;
- Environmental Reserve Quotes market;
- development of agricultural techniques;
- wildfires;
- mastery of planting techniques.

The blue lines indicate positive relationships between the variables (if A increases, then B also increases) and the orange lines indicate negative relationships (if A increases, then B decreases). The width of the line indicates the strength of the relationship: the thicker the line, the greater the number of mentions of A's influence on B, and the thinner, the fewer the number of mentions. The arrow indicates the direction of the relationship (A influences B).



Other factors that influence decision-making for soybean producers in MATOPIBA

Potential income generation from native vegetation

The sale of carbon credits was indicated as a possible source of income from areas of natural vegetation by over 70% of the respondents, followed by receiving a PES, with nearly 60% agreement.

Regarding the market that pays for the conservation of areas of natural vegetation:

64% are interested in accessing it;

60% do not understand how it works;

more than **80%** stated not having access to it.

Regarding information access:

more than **85%** indicated having access to information about agricultural techniques and practices, climate, soybean market, and finances through representatives of input suppliers, WhatsApp groups, information channels and websites available on the internet, or paid and free mobile applications;

but only **70%** claim to have **access to environmental legislation** through lawyers or environmental licensing consultancies.

Almost all of the respondents believe that it is possible to increase productivity without expanding the production area. The exceptions are those who believe they have already reached maximum productivity in their crops (close to 90 bags/ha).

Perception of threats and risks to business

Soybean producers showed awareness and concern about the risks to cultivate and commercialize the crop. **Over 70% agreed that the following factors pose a threat to the business:**

1. **Market factors,** such as changes in the local economy and politics and importation policies from China and Europe, and fluctuations in product prices.
2. **Institutional factors,** such as changes in environmental policies, elimination or reduction of government support to farmers.
3. **Environmental factors,** primarily related to the climate.*

*Despite the perception of this risk, many producers do not believe in climate change, justifying that severe droughts have always occurred and repeat every 4-5 years.

4. **Production factors,** such as crop diseases or pests, productivity index, changes in technologies, and increase in production costs.

Plans for the future

1 Increase productivity in areas where production already happens:

"—90% of the gain comes from the soil, so it is necessary to ensure that it is in perfect condition to nourish the plant."

Reasons:

- clearing (deforesting) or purchasing more land is expensive and labor-intensive;
- there is no more available land for planting in the interviewee's region, so expanding the planting area is not possible;
- older lands are more productive than newly cleared lands.

Strategy

- invest in soil quality to ensure long-term sustainability:
- invest in the acquisition of machinery;
- acquire a variety of modern seeds adapted to local climate and soil;
- implement precision agriculture;
- adopt the use of biological inputs.

Barriers:

- lack of own financial resources;
- high interest rates from banks for financing the purchase of inputs;
- dry season in the Cerrado, which hinders the safe planting of a third annual crop;
- apprehensions and uncertainties regarding the political scenario at the time of the interview.

2 Expand cultivation area.

"—We plant not only for the sake of profits, but also out of love and devotion to the land.".

Reasons:

- increase production;
- availability of areas, particularly in Maranhão and Piauí, which present high potential for soybean expansion, both in terms of area and demand;
- financial return and land appreciation;
- love for agriculture;
- desire to contribute to local and national social and economic development.

Aspects considered:

- areas to be opened are already owned by them;
- availability of financial resources (own funds) to obtain the necessary permits to supress vegetation, clear, and correct the soil;
- agricultural suitability of the specific area (edaphoclimatic characteristics);
- proximity of the new area to existing cultivated areas (logistical convenience);
- the price of the land. The mental calculation made by producers considers the expenses involved in clearing and preparing virgin land versus the value of already opened and ready-to-plant properties, taking into account the quality of the local soil.

Barriers:

- low availability of skilled labor for land clearing and production. The removal of stumps, roots, and stones required after vegetation clearing is mostly done manually, demanding a large number of temporary workers, as few producers have access to appropriate machinery;
- high land prices in certain regions of MATOPIBA;
- high cost of land clearing;
- threat of a left-wing government implementing a soybean export tax;
- obtaining the necessary permits for vegetation suppression.

Opportunities for the restoration or voluntary conservation of native vegetation on cattle ranches and properties of producers of other crops.

Areas suitable for soybean cultivation.

The majority of cattle ranchers and producers of other crops in areas suitable for soybean cultivation stated that they are not interested in selling or leasing their property to soybean producers for the following reasons:

1. **Sentimental value of the land, as it is a family inheritance;**
2. **The land being the sole source of livelihood for the family;**
3. **Sense of belonging to the local area;**
4. **Lack of full ownership of the property (due to multiple owners, whether family or not);**
5. **The "*fear of the unknown*" if they were to get rid of the rural property.**

Areas unsuitable for soybean cultivation

Although they are not directly of interest for soybean expansion, areas unsuitable for soybean cultivation are indirectly coveted due to the migration of pastures from "suitable" areas to "unsuitable" areas. Therefore, it is important that these areas are also considered by programs aimed at reducing deforestation.

Small-scale cattle ranchers and producers of other crops residing in these areas mentioned environmental benefits such as improved climate, regulation of rainfall, and animal well-being as the main motivation for voluntary conservation of native vegetation.

"— The world needs more trees. Nowadays, people are primarily focused on their own well-being, and not on making the world a cleaner place... they want to profit over everything else".